DAM MANAGEMENT PLAN

Drowns Dam (State Dam ID #184.04)

Figure 1 – Dam and outlet structure, photos taken August 2005.

Introduction

Drowns Dam (lat. 43^{o} 06' 26", long. -71^{o} 07' 31") is one of four dams that store water in Pawtuckaway Lake. The dam is located on the north side of Pawtuckaway Lake off of Fernald Road in Nottingham, New Hampshire. Drowns Dam is located in the drainage of Mile Brook, which flows north to the Bean River, a tributary of the North River. The North River flows southeast to join the Lamprey River immediately upstream of the start of the Lamprey Designated River in Epping, New Hampshire. Drowns Dam is approximately 10 miles upstream of the start of the Designated River. The dam is owned by the State of New Hampshire Water Division (see contact information). The dam is active and its use is for recreation.

Dam Design

The dam was constructed in 1842 and reconstructed in 1964. The dam is constructed of concrete, stone and earth materials and has a concrete outlet structure with slots for wooden stop logs (Figure 1). A single stop log bay allows operation of releases from the dam. Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, which owns the dam. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Minimum Flow, Flowage Rights or Contractual Obligations

A lake level investigation and hearing set the desired operating water levels for Pawtuckaway Lake as memorialized in The Notice of Decision of Determination of Lake Level (DES 2000). Drowns Dam is operated to maintain these water levels, which are managed to serve public interests including recreational opportunities, aquatic habitat, and water quality. Seasonal drawdown levels were established to provide for spring flood abatement. The Notice declared that "[t]he annual drawdown

level for Pawtuckaway Lake shall be maintained at seven feet in order to achieve a lake level of 18 feet by November 30th and a lake level of 25 feet at the gauge on the Dollof Dam by June 1st." A lake level of 25 feet is considered full pool.

Riparian Property Obligations or Agreements

DES uses Drowns Dam to maintain the lake levels as established by the 2000 DES Notice of Decision and by approximating the historical median values. Summer lake level is maintained at 25 feet as measured on the staff gage at the dam. In the fall, depending on water level conditions, but generally beginning late September to early October, water is released in conjunction with Dollof Dam at the southwest end of the lake, so that the lake level is reduced to about 18 feet by November 30, where it is maintained through the winter. After the winter ice begins to melt in late February or March, stoplogs are added to reduce the outflow from the dam and refill the lake to its full lake stage of 25 feet by June 1 (DES 2000).

Water Quality Requirements or Limits

There are no site-specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Drowns Dam (Pawtuckaway Lake) is 11,700 acre-feet (ac-ft), while its permanent storage volume is 11,500 ac-ft, with the difference being 200 ac-ft (8.7 million cu. ft. or 65 million gallons). The permanent storage of Pawtuckaway Lake is the largest within the Lamprey River Water Management Planning Area. The drainage area behind the dam is 21 sq. miles, which due to its large area provides considerable runoff potential for refilling the impoundment. Therefore, the potential water available for flow management from this dam, along with Dollof Dam, is the highest when compared to the other dams in this Water Management Planning Area.

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Release volumes were assessed for the Lamprey Designated River to meet catastrophic and persistent conditions. The assessment identified the flow that would offset 90 percent of the occasions when the protected instream flows were not met. The assessment covered the events between 1975 and 2006. Because of uncertainties, an additional 20 percent was added to this flow as a contingency. Sufficient water is available in Pawtuckaway Lake to support the protected instream flows on the Lamprey Designated River. However, release volumes for most bioperiods were apportioned between Pawtuckaway Lake and Mendums Pond, because of the availability of additional water from that location.

During the bioperiods of early summer through early fall (Clupeid Spawning, GRAF Spawning, and Rearing and Growth), protected instream flows can be supported by relief flows released from storage in Pawtuckaway Lake. At the proposed release volumes the estimated total water level change is 0.21 feet from releases during all three of these bioperiods.

In the fall, the annual seven-foot drawdown release currently meets most of the Salmon Spawning bioperiods instream flow needs without active management for protected instream flows. Active

management of the annual fall drawdown under the Water Management Plan would continue to provide all the water necessary for this bioperiod's protected instream flow on the Lamprey Designated River and allow some water to be retained in storage for Overwintering releases.

During the Overwintering bioperiod, relief flows will be provided from water retained from the annual fall drawdown. As the Spring Flood bioperiod approaches, depending on spring flood storage needs, the water stored for the Overwintering bioperiod can be saved to maintain stream flows during the Spring Flood bioperiod, or released before the Spring Flood bioperiod to provide additional flood storage.

No active management of flows during the Spring Flood bioperiod is planned under the current version of the Water Management Plan because it appears unnecessary at this time. At the end of the Spring Flood bioperiod, the water level should again be at full lake level with sufficient storage to support management during the next three bioperiods of early summer through early fall.

Potential Impacts of Storage and Release of Relief Flows

Except for Burnham's Marsh, there is little mapped as wetlands within the impoundment area of the dam. Burnham's Marsh is separated from the lake by Burnham's Marsh Dam, so the storage or release of water from the dam for flow management would have little potential impact on wetlands in Burnham's Marsh.

Mapped wetland areas are present below the dam in the riparian area along the Pawtuckaway River. These wetlands could reduce the effectiveness of any flow released from Drowns Dam by temporarily storing the released water. Insufficient information is currently available to determine the amount of water that could be stored by these wetland areas and the resulting impacts on a flow management release.

Managing water levels on Pawtuckaway Lake for the purpose of flow management on the Lamprey Designated River should not have a significant effect on shoreline properties or on recreational opportunities on the Lake. The volume of water to be released during the three early-summer to early-fall bioperiods is estimated to result in a change in water level from full pool of 0.21 feet. Somewhat greater water level change must be expected if the initial water level is significantly lower. The fall bioperiod flows are currently met by the annual, seven-foot, fall drawdown of the lake. It is not clear what will be the effects of reducing the fall drawdown to store water for releases during the Overwintering bioperiod, but 55 percent of those polled in 2000 were in favor or accepting of conditions that changed the fall drawdown to a lesser amount. No releases are proposed for the Spring Flood bioperiods and so no impacts are expected so long as any water stored during the winter is released previously for flood storage. Pawtuckaway Lake is expected to be at full pool following the spring bioperiod.

Potential for Dam Management to Support Instream Flow Requirements

The overall potential for using Drowns Dam for flow management to support the instream flow requirements on the Lamprey Designated River is high due to the public ownership of the dam, the amount of storage potentially available, the large drainage area above the dam, the existence of an

outlet structure designed to manage water levels and its proximity to the beginning of the designated river. Pawtuckaway Lake is controlled by two operable dams. Releases from Pawtuckaway Lake are able to come from either Dollof Dam or Drowns Dam or from a combination of both dams. When compared with Dollof Dam, Drowns Dam is slightly closer to the beginning of the Lamprey Designated River (10 miles versus 14 miles.) Dam releases to provide for flow management will be coordinated with the timing and volume of Dollof Dam releases.

Dam Management Activity Proposed

Drowns Dam's primary use is described by the Dam Bureau as recreation. The use of Drowns Dam will be expanded to include instream flow. Releases from Pawtuckaway Lake may come from either Dollof Dam or Drowns Dam, or from a combination of both dams. The proposed Dam Management Activity will require a revision of the existing Notice of Decision (DES 2000) and this proposed change will be presented as discussed at a public hearing.

When water management activities are necessary, water will be released from Drowns Dam to create relief flows to support the protected instream flows on the Lamprey Designated River. Flow management releases will occur when daily mean discharge falls below the Critical or Rare protected flow magnitudes for longer than its catastrophic duration (DES 2009) during five of the six bioperiods. A flow management release will also be initiated when catastrophic conditions occur as a result of repeated persistent events. If a flow management release is needed then a two-day relief flow will be released from the dam. Flow conditions will be evaluated based on the records from the United States Geological Survey gaging station Lamprey River near Newmarket, New Hampshire (0173500).

For Drowns Dam, relief flows will be released to support the protected instream flows during five of the six bioperiods. No relief flows will be released during the Spring Flood bioperiod (March 1 to May 4). For the Clupeid Spawning, GRAF Spawning, and the Rearing and Growth bioperiods (May 5 to October 6), relief flows will be generated by releases from both Mendums Pond and Pawtuckaway Lake, with the volume released proportional to their surface area. Protected instream flows for the Salmon Spawning bioperiod will continue to be met by active management the annual fall drawdown of Mendums Pond and Pawtuckaway Lake. Relief flows during the Overwintering bioperiod (December 9 to February 28) will be from water retained in Pawtuckaway Lake from the annual fall drawdown.

Each of the bioperiods except Spring Flood has a bioperiod-specific flow to be released as the relief flow. The volume of water to be added to the release, and its equivalent discharge value and the estimated water level decline for each bioperiod are summarized in Table 2. The relief flow volume and flow rate values in Table 2 are based on meeting the Rare and Critical flow requirements 90 percent of the time with a 20 percent buffer added. The twenty percent buffer recognizes there are unknowns in the attenuation of flow between the release and the Designated River and having a single release event per bioperiod.

The DES Instream Flow Program will provide notification to the owner of an impending flow management release. DES Dam Bureau as the owner of the dam will be responsible for the operation of dam to support the protected instream flows on the Lamprey Designated River. The Dam Bureau will take such actions necessary to remove stoplogs from Drowns Dam to increase flow from

Pawtuckaway Lake by the amount shown in Table 2 beginning at a start time identified by the Instream Flow Program.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice after adoption of the Lamprey Water Management Plan and after DES review the 2000 Notice of Decision of Determination of Lake Level. A public hearing will be held relative to revising the Notice of Decision to allow for a reduced fall drawdown to store the water necessary for a winter release.

Estimated Cost of the Implementation of the Dam Management Plan

The specific actions associated with the implementation of the Dam Management Plan for Drowns Dam would include the placement or removal of stop logs from the dam. This work would require that, at least, one trained DES employee travel to the site to either place or remove a pre-determined number of stop logs from the dam structure. These trips are expected to also include management actions at Dollof Dam and Mendums Pond Dam. The estimated costs associated with this work will be dependent upon the number of personnel involved, the number of site visits required to perform the necessary flow management actions and the travel time and mileage.

Dam Owner and Contact Information

Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
Phone: 603-271-1961
Email: jgallagher@des.state.nh.us

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

References

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Department of Environmental Services (DES) 2000. Notice of Decision on Determination of Lake Level. Dated December 19, 2000.

Department of Environmental Services (DES) 2009. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Table 1 - Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**241.30**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**18**
Freeboard (ft)	**NA**
Type of spillway controls or outlet works	**Stop Logs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**900**
Drainage area (sq. miles)	**21**
Maximum storage (ac-ft)	**11,700**
Normal or permanent storage (ac-ft)	**11,500**
Total discharge capacity (cfs)	**1,631**
Maximum unoperated discharge (cfs)	**NA**
Design storm discharge (cfs)	**2,080**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**290**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #184.04.

Note:

NA – not available from NH Dams Data Sheet.

Table 2 - Flow releases meeting 90 percent of the historical 30-year Protected Instream Flow deficits (1976-2005) and the calculated changes in water level from full pool

Bioperiod name	Period	Volume needed to meet 90% of historical deficits (ac-ft)	Volume needed to meet 90% of historical deficits with 20% buffer (ac-ft)	Equivalent two-day flow release (cfs)	Change in water level from full pool using releases that meet 90% of historical deficits w/ 20% buffer (feet)	Water source
Overwintering	Dec 9 – Feb 28	216	259	65	0.33	Mendums Pond not used
Spring Flood	Mar 1 – May 4	-	-	-	-	No active management planned
Clupeid Spawning	May 5 – Jun 19	88	106	27	0.14	from storage and drawdown
GRAF Spawning	Jun 20 – Jul 4	15	18	5	0.02	from storage and drawdown
Rearing &Growth	Jul 5 – Oct 6	35	42	11	0.05	from storage and drawdown
Salmon Spawning	Oct 7 – Dec 8	56	67	17	0.09	from fall drawdown release
Sum of Clupeid to R&G		138	166	-	0.21	
Sum		410	492	-	0.63	

Change in water level is based on a starting point of full pool. Lower starting points will result in larger changes in water level.
Total water level change assumes that each of the bioperiods needs one relief flow during the year.
Assumes the end of the Spring Flood bioperiod's water level starts with a full recreational pool.
Pawtuckaway 783 Acres at full recreational pool